CHAPTER 3

PREFLIGHT PROCEDURES AND SUCCESS CRITERIA

3.1. Introduction. This chapter describes standards and procedures for activities leading up to the release of the radiosonde and its train and for the determination of the end or completion of a valid sounding.

3.2 Safety Considerations. Safe practice procedures ***shall*** be followed for all pre-release and release activities. The following require special attention to safety guidance:

- location of any high tension electrical lines antennas, masts, etc. and procedures for removal of radiosondes and/or balloons which might become entangled during a release,
- movement of the assembled radiosonde train about, indoors and outdoors,
- exposure to potentially hazardous weather and terrain during the balloon release,
- employment of equipment such as weights, valves, and other hardware,
- operation of electrical and electronic equipment,
- use of hydrogen, helium, or natural gas, and
- clearance from FAA tower or ship's commanding officer.

3.3 Flight Equipment Prerelease Actions. Observers ***shall*** be cognizant of the wind and weather conditions and expected air traffic in the vicinity of the station prior to commencing an upper-air observation. For instance, the exposure and warm-up times required for the various types of equipment must be considered and the agency guidelines determining the order in which preliminary operations are to be performed must be followed. Expendables ***should*** be periodically checked to ensure an adequate supply to maintain observations without interruption. Batteries used with the various radiosondes ***should*** be prepared in accordance with the manufacturer's instructions. In the event of a second or subsequent release, the radiosonde ***shall*** be tuned to a different frequency to avoid interference with previously released radiosonde(s).

3.3.1 Balloon Inflation and Performance. The burst altitude of a balloon is affected by:

- the free lift (number of grams of lift available over and above that required by a balloon to just support the weight of a complete flight-train and radiosonde),

- the air mass(es) through which the balloon ascends and the weather conditions to which it is exposed, and

- the thickness of the balloon skin and the size and shape of the balloon envelope.

Ascent rate is affected by free lift and drag. The amount of free lift required for producing optimum performance ***shall*** be determined before the balloon is inflated. Optimum performance is usually defined as the highest possible bursting altitude with an average ascension rate favorable for obtaining winds aloft data and for properly ventilating the radiosonde sensors (RH and temperature). The balloon must be sufficiently inflated to ensure successful release in the surface conditions which may exist at the time. These factors include, but are not limited to, the following considerations:

- During fair weather conditions, optimum performance and free lift will normally be achieved with 800-1300 grams of hydrogen or helium for 600-1200 gram balloons; 800-1000 grams of hydrogen or helium for 300 gram balloons; and 600-800 grams of hydrogen or helium for 100 gram balloons. The standard, average ascension rate ***should*** be 300 meters per minute. However, consideration should be given to how individual balloons produced by different manufacturers will perform based on their shape and thickness characteristics. Refer to manufacturer's instructions for recommended gas inflation amounts for specified ascension rates.

- The performance obtained by preceding flights ***should*** be considered in selecting a free lift value to be used.

- When precipitation, icing, or terrain turbulence is occurring, sufficient free lift ***shall*** be provided to ensure that the balloon will not descend or float. An increase of 100 grams free lift is typically sufficient to compensate for an increase in the weight of the train resulting from light precipitation. Under light or moderate icing conditions, moderate to heavy precipitation, or terrain turbulence induced by high surface winds, an increase in free lift of 200 to 300 grams will usually be sufficient. Under severe icing conditions, an increase of 500 grams or more *may* be required.

3.3.2 Balloon Inflation. Specific procedures for inflating balloons are contained in Appendix B.

3.3.3 Flight-Train Assembly. The train consists of the balloon, parachute, cord, regulator, and radiosonde plus lighting and shock units as appropriate. Assembly procedures ***shall*** be designed to minimize strain on the balloon neck, avoid entanglement of train components, reduce risk of collision with ground obstacles, and prevent unrepresentative atmospheric sensing.

Under normal conditions, a train length of about 26 meters (85 feet) ***should*** be used. Trains in excess of about 36 meters (120 feet) ***should not*** be used because they can induce excessive pendulum motion of the radiosonde and signal dropout leading to premature flight termination. Trains of less than about 21 meters (70 feet) in length ***should not*** be used. Short trains increase the risk of the radiosonde being too close to the radiation environment of the balloon or of encountering the balloon's wake as it ascends, thereby placing the radiosonde in disturbed and unnatural conditions. Longer train lengths *may* be used with radiosondes employing GPS technology. The length of line between the balloon and parachute ***should*** be 1.5 meters. (Refer to Figure 2-1).

3.4 Preparing the Radiosonde for the Preflight Check. The radiosonde ***should*** be physically inspected prior to being prepared for the preflight check. If the frequency check was done more than twelve hours prior to the sounding, the radiosonde frequency check ***shall*** be redone before the preflight check. The radio frequency of 1680 MHz radiosondes ***shall*** be adjusted to within ± 2 MHz of 1680 MHz or the 403 MHz radiosondes to within ± 1 MHz of 403 MHz.

3.4.1 Calibration of the Radiosonde Sensors. Preflight calibration of the sensors ***shall*** be performed to ensure that electronic signals from the radiosonde sensor circuits, with sensors in a controlled environment, are in agreement with data furnished with the radiosonde or with known surface conditions. This procedure is designed to ensure the radiosonde is functioning within acceptable tolerances prior to release and ***should*** be completed prior to entering administrative or surface data into the ground station computer. A check ***should*** be made of the accuracy of the temperature and relative humidity sensors. This can be done by comparing the radiosonde measurements with those taken by agency-approved instrumentation. The comparison may be done inside or outdoors. If the comparison is done outside, the radiosonde ***shall*** be acclimated to the ambient air before the comparison is made. The location of the instrumentation and radiosonde ***shall*** be as close as possible to each other. During this comparison the radiosonde ***should*** be suspended or placed on a non-conductive surface away from metallic or solid surfaces. If the comparison values are outside the range plus or minus 1°C for temperature and plus or minus 10% for relative humidity, the radiosonde ***shall*** be allowed to acclimate an additional 5 minutes. If the radiosonde fails this check a second time, it ***shall*** be rejected and another used.

3.4.2 The Surface Observation A surface observation as close as possible to the time and place of the release ***shall*** be made. Procedures for recording the observation are to be provided by the individual agencies. Station pressure ***shall*** be taken to the nearest tenth of a hectoPascal (hPa), and corrected for the appropriate pressure at the release point. A measurement of air temperature ***shall*** be taken and recorded to the nearest tenth of a degree Celsius. A measurement of humidity ***shall*** be taken and recorded such that the dew-point temperature is specified to the nearest tenth of a degree Celsius. Wind speed and direction appropriate to the release point ***shall*** be recorded to the nearest whole nautical mile per hour (knot) and 5 degrees for archival purposes. Clouds and weather ***shall*** be observed and reported as the "41414 $N_hC_LhC_MC_H$" group using 41414 and a five digit code to describe surface observed weather and cloud conditions at the time of the radiosonde observation. See Appendix E, E-II.2.8, for coding instructions. Note: the code to describe the state of the weather, wwww, is not required for international data exchange; it is required for archival purposes.

3.4.3 NAVAID Radiosonde. Observers using radiosondes that need navigational aid signals such as LORAN or VLF for computation of upper level wind data ***should*** follow manufacturer's instructions to prepare their system to properly receive the navigation signals. The latest information ***should*** be consulted regarding the availability of navigation stations, such as off-the-air, down for maintenance etc. Bulletins are routinely issued by responsible agencies (such as the U.S. Coast Guard.)

3.4.4 Release Notifications. Federal Aviation Regulations (FAR) Part 101, Moored Balloons, Kites, Unmanned Rockets, and Unmanned Free Balloons (Ref. 5), specifies notification requirements. Notification requirements for release near civilian airports or military airfields are as follows:

For Controlled airports with Air Traffic Control Tower (ATCT) in operation.

- ATCT ***shall*** be informed in accordance with agency procedures before the intended release time, and

- ATCT clearance ***shall*** be obtained prior to the actual time of release.

For Non-controlled Airports that do not have ATCT or whose ATCT is not in operation:

- a release notification broadcast on the local Flight Services Station and/or the local airport's UNICOM frequency ***shall*** be attempted.

For Military Activities:

- upper-air units operating within an eight km (five mile) radius of a military airfield ***shall*** provide the commander with a schedule of observations, and

- ATCT clearance at actual time of release ***shall*** be obtained.

- Upper-air units operating on a vessel underway ***shall*** notify the launch vessel's Tactical Action Office (TAO) or Officer of the Deck (OOD) of the intent to release, and, further, ***shall*** obtain release authority from either the TAO, OOD or both prior to release.

3.5 Notice to Airmen (NOTAM). Routine rawinsonde/radiosonde observations are, in general, exempt from the provisions of FAR 101 (Ref. 5) relative to filing a NOTAM for the following reasons:

- radiosondes do not weigh more than four pounds or have a weight/size ratio of more than three ounces per square inch on any surface of the package,

- balloons do not carry a total payload package weighing more than six pounds,

- balloons do not transport two or more packages that weigh more than twelve pounds, and

- trains do not use a rope or other device for suspension of the payload that requires an impact force of more than fifty pounds to separate the suspended payload from the balloon.

Any station that launches a balloon, connecting train, or payload equaling or exceeding the limits shown in this paragraph ***shall*** comply with Subpart D of FAR 101. Agencies ***shall*** ensure that any of their stations which launch large observational packages have a current version of FAR 101 available for reference and compliance.

As with any other Federal Regulation, FAR 101 is subject to change from time to time.

3.6 The Release. Release ***shall*** be made immediately following completion of the release notification. Safety procedures relevant to the local site and weather conditions ***shall*** be followed. The radiosonde ***should*** be held at arms length and swung back and forth to force ambient air over the humidity sensors. The unit ***should not*** be placed on the ground at any time.

The actual release time expressed in terms of the 24-hour clock (UTC) ***shall*** be recorded to the nearest minute for use in the coded message. Midnight (UTC) ***shall*** be expressed as 0000 and regarded as the beginning of the day. Normally all rawinsonde stations operated in the coterminous U.S. take observations at 0000 and 1200 UTC. Stations in WMO Region IV that are unable to carry out the full upper-air program ***should*** give priority to the sounding scheduled for 1200 UTC (Ref. 12: II 3). (Stations in the Pacific Ocean sector *may* be exempted from this choice.) The actual release time of the regular radiosonde soundings ***shall*** fall within the time interval from 45 minutes before to the scheduled time of the observation (see para. 7.4 and Ref. 12:2.3.11.)

For all non-standard observation times the release window, in regard to the recorded time of the observation, is from 30 minutes before to 29 minutes after the hour of assigned observation time.

3.6.1. Release into Thunderstorms. For considerations of safety, a radiosonde ***shall not*** be released in or near thunderstorms. (An exception *may* be made, under agency control, because of research or other needs.) Thunderstorms can degrade the radiosonde signal, which results in early termination of the flight. Also, the resulting data provides profiles that are unrepresentative of the synoptic pattern. Chapter 4 describes how thunderstorms can affect the telemetered data quality.

3.6.2. Delayed Release. The radiosonde ***should*** be released within the officially prescribed time limits. If a release is delayed beyond the time limit, careful consideration ***should*** be given to replacing the battery to preclude battery failure during flight. Use the time limits set by the manufacturer in determining whether the battery be replaced. If a battery is replaced, preflight and exposure (see para. 3.4) procedures ***should*** be repeated.

3.7 Termination of Radiosonde Observation. The termination of a successful flight normally occurs when the balloon bursts or stops rising. However, some other occurrences could be cause for termination.

3.7.1 Due to Missing Data. Whenever a stratum of missing temperature data (see Chapter 4, Quality Control) is followed by a satisfactory record, the computations ***should*** be continued provided the stratum or strata of missing data do not exceed the limits given in Table 3-1. The flight ***should*** be terminated if at any time the limitations of missing temperature data are met or exceeded. The Table represents the maximum tolerable amount of missing data, expressed in both strata thickness and time interval. Agencies *may* enforce stricter limits.

Whenever a stratum of missing pressure is followed by a satisfactory record, the computations ***should*** be continued provided the stratum does not exceed a limit that causes the determination of geopotential heights to be unsatisfactory. (This limit is less restrictive than that of temperature because of the nature of the hypsometric equation, Appendix D, D.2.) Chapter 4, para. 4.2.1.2, contains the specification of this limit.

The occurrence of missing relative humidity data is not considered justification for termination of the sounding unless the responsible agency deems otherwise.

Whenever the limits are exceeded in one stratum of missing data, the computations ***should*** be terminated at the base of the stratum. Whenever the limits are exceeded in the summation of several strata of missing data, the observation ***should*** be terminated at the base of the stratum in which the limits are exceeded.

3.7.2 Due to Weak Signal. Weak or fading signals can result from a weak battery, a radiosonde moving too far away, or a ground tracking antenna that is not correctly locking onto the radiosonde signal (Chapter 4).

3.7.3 Other Causes for Termination. In the event that the quality of the telemetered data becomes questionable and the criteria covered above are not met, the ascent *may* be terminated. See Chapter 4 for details.

3.8. <u>Successful/Unsuccessful Observation Criteria</u>. All U.S. network (synoptic) radiosonde sites ***shall*** track the radiosonde to the natural termination of the observation and record and evaluate usable data to the highest altitude possible. A second release is required whenever the radiosonde terminates at a pressure greater than 400 hPa. Whenever necessary, a second radiosonde ***should*** be released as promptly as possible in order to stay within the time limits of scheduled observation (see para. 3.6.2 for instructions concerning delayed observations.) However, if, because of unfavorable atmospheric conditions or other reasons, it is apparent that a pressure equal to or less than 400 hPa cannot be attained in subsequent attempts, an additional release ***should not*** be made. If a second release is not made and the record from the first one is usable, even though it did not extend to a pressure equal to or less than 400 hPa, the record from the

Table 3-1 Termination Due to Missing Temperature Data: Maximum Tolerable Amounts

Pressure Range (hPa)	Strata Thickness (km)	Minutes of Missing Data
Surface to 700	1	3
Surface to 400	2	6, with above satisfied
Surface to 100	4	12, with above satisfied
1070 to termination	5 (less than 100 hPa)	16, with above satisfied

Note: The relation shown between strata thickness and time assumes a standard ascent rate of about 300 meters per minute: the maximum tolerable stratum thickness should be used.

first release ***should*** be evaluated and used for summary and transmission purposes. (When a second release is required but not made, the reasons for the omission ***should*** be stated fully in the "Remarks" section of the observational forms for the first release, if evaluated; otherwise, on the observational forms for the next succeeding radiosonde.) If a second and succeeding release does not reach the required minimum altitude, the ascension providing the greatest amount of data ***should*** be evaluated and used as the official observation.

3.9 Multiple Releases. A second or third release *may* be necessary when flight equipment or ground equipment fail, causing a premature termination of the observation. The limit for releases in attempting to complete a scheduled synoptic radiosonde observation is three. If a third release does not meet the criteria for a successful observation, further release attempts ***shall not*** be made and the data from the single most complete observation ***shall*** be disseminated unless missing data occurred in each of the observations that exceeded the tolerances in Table 3-1. In this case, ***no*** observation ***shall*** be reported.

3.10 Unscheduled or Special Observations. Special observations are those performed outside the standard times of scheduled synoptic observations (para. 3.6), and are generally under agency control. Special observations taken by designated network upper-air units ***shall*** adhere to all the basic requirements for the synoptic observations unless severe weather, equipment limitation, or other factors warrant early termination. Special observations ***shall*** be transmitted and archived in the same manner as scheduled synoptic observations.